How Do Speakers Choose Uncertainty Phrases to Express Guilt Probabilities?

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Abstract

Many studies have documented what listeners understand when uncertainty is communicated to them verbally. Yet we still know little about the factors that will influence speakers' choice of a probability phrase over another when they wish to communicate uncertain facts. Using a legal setting, we showed that the quantitative meaning and the directionality of the verbal probability chosen were affected by both the uncertain outcome's numerical probability and its perceived propensity of guilt. The discussion of these results will focus on implications for the understanding of speakers' choices of verbal probability phrases and for risk-framing in legal contexts.

Keywords: Uncertainty; Verbal probability; Directionality; Propensity; Risk communication.

A police officer (PO) and a defence lawyer (DL) are having a conversation about a suspect.
PO: "There is a chance that the suspect is guilty."
DL: "Yes, but it is not certain that he is."
PO: "I think there is a real possibility he is guilty."

People use a wide variety of words such as "it's possible" or "there is a chance" to qualify uncertain outcomes. Unlike precise numerical probability estimates, probability words communicate vague uncertainties and convey directionality by focusing attention on either the occurrence or the non-occurrence of the outcome they qualify (Teigen & Brun, 1995). Many studies have helped gaining a better appreciation of what listeners understand when uncertainty is communicated to them verbally (for a recent review, see Teigen & Brun, 2003). Yet communication situations involve at least two parties: a listener and a speaker. We still know little about the factors that will influence speakers' choice of a probability phrase over another when they wish to communicate uncertain facts. The objective of this research is to start filling this knowledge gap.

What's in a verbal probability?

Uncertainty is most naturally expressed using verbal probabilities in daily communications (Erev & Cohen, 1990 ; Brun & Teigen, 1988 ; Teigen & Brun, 1995 ; Moxey & Sanford, 2000) or in professional settings (Beyth-Marom, 1982). Verbal probabilities are often conceptualised as having two properties. First, they express a *vague degree of uncertainty* defined by a range of probability values. Thus, in the example above, when the officer said "There is a chance that the suspect is guilty", the hearer may interpret that the probability the suspect is guilty lies somewhere between 30% and 40% (Beyth-Marom, 1982 ; Budescu, Weinberg, & Wallsten, 1988 ; Wallsten, Budescu, Rapoport, & Zwick, 1986 ; Budescu, Karelitz, & Wallsten, 2003). Such vague meanings are often conceptualized using *membership functions*, which represent the extent to which each value of the numerical probability scale "belongs" to the meaning of a given verbal uncertainty expression (Wallsten et al., 1986).

The second property of verbal probabilities relates to their *directionality* (Teigen & Brun, 2003 ; Budescu et al., 2003 ; Honda & Yamagishi, 2006). Thus *positive* verbal probabilities calls hearers' attention to the outcome's truth or occurrence. For example, by saying "There is a chance that the suspect is guilty", the officer calls the listener's attention to the possibility that the suspect may indeed be guilty. Conversely, *negative* verbal probabilities focus hearers' attention on the possibility that the uncertain outcome is false or will not occur. Thus, when replying "It's not certain", the defence lawyer is refocusing attention on the possibility that the suspect may not be guilty after all. Directionality is a very important feature of verbal probabilities because it can affect *hearers*' reasoning and decision making (Teigen & Brun, 1999).

This also means that speakers' choice of a given verbal probability is also consequential. Speakers have to choose from a large array of expressions the one that will best convey the uncertainty degree they wish to communicate while appropriately focusing the hearer's attention on either the outcome's truth or falsity. But how speakers choose what degree of uncertainty they wish to convey or when they may want to focus on the truth rather than the falsity of an outcome are open questions few studies have explicitly attempted to answer. Studies on hearers' interpretations of verbal probabilities, nevertheless, can provide valuable information on what may underlie speakers' choice processes.

How may speakers choose verbal probabilities?

From a purely quantitative perspective, verbal probabilities are interpreted as communicating a range of probabilities, conceptualised as membership functions and directionality is merely embedded in this vague numerical meaning. This is supported by the finding that the shape of membership functions (i.e., their peak and skewness) can suffice to predict directionality in 85% of cases (Budescu et al., 2003).

Accordingly, we can expect that the typical value communicated by the verbal probability chosen by speakers will be influenced by the objective numerical probability they intend to convey (Hypothesis 1). Moreover, we expect that the directionality of this verbal probability will also be influenced by the underlying objective probability (Hypothesis 2a).

Proponents of a more pragmatic perspective, in contrast, have argued that verbal probabilities "do not arrive in our heads as a set of numbers" (Teigen & Brun, 2003, p. 125) and that verbal probabilities, through their directionality, have a communicative function that is distinct from that of communicating a range of probability values (Teigen & Brun, 1995, 1999, 2000 ; Honda & Yamagishi, 2006 ; Moxey & Sanford, 2000). For example, directionality can inform decision-making. Teigen et Brun (1999) showed that people receiving messages including words referring to probabilities of similar magnitudes (about 30% probability) made very different recommendations: 90% recommended a treatment when its success was characterised by a positive probability word whereas only 32% did so when the likelihood of success was described with a negative probability word.

These latter findings suggest that a speaker may not only consider the numerical probability values they are trying to communicate but also take into account the point of focus they wish to highlight. Thus, in the conversation between the officer and the defence lawyer mentioned earlier, both parties may agree on the numerical probability of the suspect's guilt yet they may choose different expressions to describe this uncertainty. What remains to be examined, however, is *what* would make someone believe and therefore utter that it is "not certain" a suspect is guilty rather than there is "a chance" he is, in fact, guilty.

We propose that the key in answering this latter question lies in a dispositional view of individuals' lay conception of probability (Keren & Teigen, 2001a). According to this view, individuals interpret probabilities in causal terms, as tendencies or predispositions of an event to give rise to a specific outcome.

Keren et Teigen (2001b) called this phenomenon the *principle of probability-outcome correspondence*. According to Keren et Teigen (2001a), the propensity of an event might lead the choice of the verbal probability used to describe this event. For example, Windschitl et Weber (1999) compared subjective probability ratings on a verbal probability scale for lowly and highly representative events (low vs. high grade students' chance to pass an exam) which were described with the same numerical probability. Even though participants knew the student had a 70% chance to pass the exam, they gave higher ratings for the student in the highly representative context ("quite likely pass the exam") than in the lowly representative context ("somewhat likely to pass the exam"). Keren et Teigen (2001a) interpreted this result according to the probability-outcome correspondence principle and proposed that the verbal probability selection were based on the candidates' perceived propensities of passing an exam.

Windschitl and Weber's study demonstrated indirectly that propensity might influence ratings location on a verbal probability scale. We propose to adapt the *principle of probability-outcome correspondence* to account for individuals' choice of verbal probabilities' directionality. We anticipate that speakers will aim to focus hearers' attention on the possible occurrence of an outcome (and hence choose a positive uncertainty expression) when the outcome has a high propensity for occurring, independently of its objective probability. Conversely, we anticipate speakers will aim to focus hearers' attention on the non-occurrence of an outcome (and hence choose a negative uncertainty expression) when the outcome they characterise has a low propensity of occurring. In other words, we propose that speakers' choice of directionality will depend on the uncertain outcome's underlying disposition, or propensity, to occur (Hypothesis 2b).

Table 1: Suspect descriptions used in the Experiment

Propensity	Description
High	Mr C is unemployed. He was recently implicated in an armed robbery involving two million euros. Mr C. was arrested and charged with robbery, possession of a weapon, and assaulting a Police officer. The charges were later dropped due to lack of evidence.
Low	Mr C. is a manager in a small bank. He was recently implicated in a fraud investigation involving two million euros. Mr C. was arrested and charged with insurance fraud and identity theft. The charges were later dropped due to lack of evidence.

Experiment

This experiment aimed to examine the determinants of speakers' verbal probability choices. The above predictions were tested in a legal setting where the uncertain outcome was a suspect's possible guilt. The objective probability of guilt as well as the propensity of guilt were manipulated in order to test for (1) the effect of the objective numerical probability on the uncertainty conveyed by the verbal probability chosen by the speaker, and (2) the effect of both the objective numerical probability and the propensity of guilt on the directionality of the verbal probability chosen (stressing either the guilt or the innocence).

Method

Participants Participants were 123 students of Toulouse II University, aged from 18 to 34 ($M = 21.75$, $SE = 2.91$, 39 males). They were all native French speakers. They volunteered to complete a 4-page questionnaire on uncertainty reasoning in a legal setting. Six did not complete the questionnaire and their data were excluded from the sample.

Material, design and procedure The experiment was based on a 2(Objective numerical probability: 80% vs. 20%) x 3(Propensity: low, high vs. indeterminate) between-subjects design. Each participant was randomly assigned to one of the six resulting conditions.

The objective probability value was presented as having been computed by a computer program based on forensic evidence. Propensity of guilt manipulations relied on manipulations of the suspect's background (see Table 1).

All the participants were presented with the same basic sce-

nario. They were first asked to imagine that they were a profiler who can be called upon to evaluate the extent to which a suspect is likely to be a crime offender and given a brief introduction to what their task would entail.

Following this introduction, they were presented with a case summary describing a very serious hold-up in a bank involving an armed individual who did not hesitate to injure a member of staff to show his determination and fled the scene with a customer as hostage who was later physically assaulted. Next, participants read about a suspect called Mr. C. was apprehended by the police. Mr C. was then either described by a high-propensity of guilt or a low-propensity of guilt profile (see Table 1), or no further description was provided (indeterminate propensity of guilt condition). Finally, all participants were given the result of a program recognised for its effectiveness, the Profiler W1 program[1]. This program was said to compare suspect and offender profiles on several points and then return a numerical probability for the suspect's guilt. Half the participants were told this numerical forecast was 20% whereas the remainder were told it was 80%.

Participants' task consisted of reformulating the computer forecast using a verbal probability phrase in order to assist the Police officer in charge of the inquiry. Directionality of the phrase thus produced was assessed using an appropriateness rating task (Honda & Yamagishi, 2006 ; Teigen & Brun, 2003). Specifically, participants were asked to use a 5-point scale to rate the appropriateness of both a pro reason ("because his profile matches that of a criminal") and a con reason ("because his profile does not really match that of the criminal") associated with the probability phrase they had produced to convey the numerical computer forecast. This task aimed to evaluate whether the verbal probability was more appropriately used with reasons arguing for the guilt or against it. This, in turn, was used as an index to evaluate the extent to which the verbal probability focused the reader's attention on the suspect's guilt or his innocence. Next, numerical meanings were elicited using the Multiple Stimuli Method for eliciting judgments of membership (Budescu et al., 2003) for the participant's probability phrase. Participants rated the degree to which the phrase they produced (e.g., It is *quite possible* that the suspect is guilty) was compatible with conveying each of a range of 10 probabilities (10%, 20% ... 100%) of guilt.

At the end of the questionnaire, participants provided with a detailed description of Mr C. were asked to judge the extent to which they expected that someone who had been implicated in an armed robbery (or an insurance fraud) could rob a bank. Judgments were recorded on a 6-point scale and were intended as a check for the propensity of guilt manipulation. Participants were not limited in time to read the scenario, or to respond to the questions.

[1]This was inspired by actual programs designed to collect, collate, and analyse crimes the police used in real life (i.e., ANACRIM and SALVAC in Europe or the VICAP in United states.

Results

Manipulation check The propensity of guilt manipulation was successful. The manipulation check showed that participants judged that an individual who had been implicated in an armed robbery *(high propensity condition)* was more inclined to be involved in a bank robbery than an individual who had been implicated in an insurance fraud *(low propensity condition)*; $F(1,79) = 4.35$, $p < 0.05$, partial $\eta^2 = .055$.

Experimental effects We first hypothesized that speakers' choice of a verbal probability would be determined by the objective numerical probability they are trying to communicate. In line with this hypothesis, we found that the peak value[2] of participants' membership functions for the word they had chosen was significantly lower when they were asked to convey a 20% objective probability compared to an 80% objective probability; $M_{20\%} = .14$, $SE = .08$; $M_{80\%} = .77$, $SE = .22$; $F(1,116) = 182$, $p < .001$, partial $\eta^2 = .62$. In other words, participants' choice of probability words was consistent with the underlying objective probability they intended to convey.

The second objective of this research was to assess the effect of the objective probability and the suspect's propensity of guilt on the directionality of the probability word chosen. To test for this hypothesis, we adapted Teigen et Brun (2003) scoring method and computed *directionality scores* by subtracting participants' appropriateness ratings for using their verbal probability with reasons against guilt from their ratings for using their phrase with reason in favour of guilt (see Method section). The resulting directionality score ranged from -5, indicating the most negative directionality, (i.e., the verbal probability produced intensely focuses on the possibility of innocence, e.g., 'it is improbable') to $+5$, indicating the most positive directionality, (i.e. the verbal probability produced intensely focuses on the possibility of guilt, e.g., 'it is very likely').

Directionality scores were subjected to a 2 x 3 Analysis of Variance (ANOVA) testing for the effect of the objective probability of guilt and the propensity of guilt on the directionality of the probability word chosen. We expected participants to choose words which directed attention towards guilt when the propensity of the suspect to commit the offense was high. Conversely, we expected them to produce words focussing on the suspect's potential innocence when their propensity to commit the crime was moderate. Results revealed no main effect of the suspect's propensity of guilt on directionality; $F(2,116) = 1.11$, $p = .33$, partial $\eta^2 = .021$. However, results revealed a significant two-way interaction term of the two factors tested; $F(2,116) = 6.72$, $p < .001$, partial $\eta^2 = .11$, illustrated in Figure 1.

To further investigate this interaction, we conducted six planned contrasts comparing directionality ratings of words produced for the high and low propensity profile between

[2]The (average) probability to which the subject assigned the highest membership value.

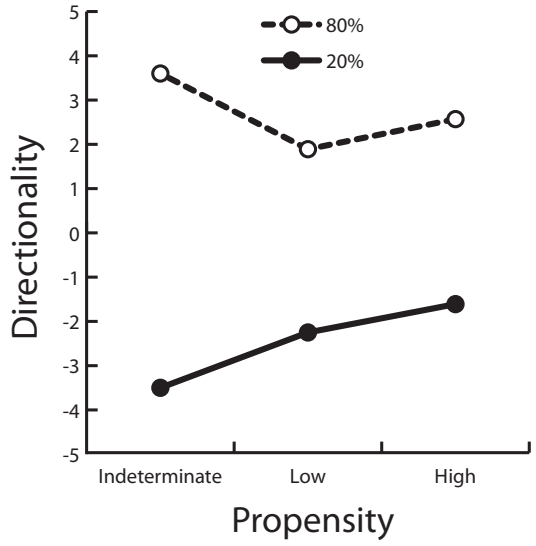

Figure 1: Mean directionality scores as a function of numerical probability values and propensity of guilt

them and with those produced in the control condition (no profile), for each of the computer forecasts. When the computer forecast was 20%, directionality scores for phrases associated with the low and with the high propensity profile were significantly higher than those for phrases associated with the control condition; $t(111) = 2.05$, $p = .04$, and $t(111) = 3.01$, $p = .003$, respectively. Directionality scores, however, did not differ for phrases produced with the high or the low propensity profile, $t(111) = 0.98$, $p = .33$.

When the computer provided an 80% probability of guilt forecast for the suspect, by contrast, directionality scores for phrases associated with the low propensity profile were significantly *lower* than those for phrases associated with the control condition; $t(111) = -2.49$, $p = .01$. However, directionality scores of phrases associated withe the high propensity profile did not differ from those elicited in the control condition; $t(111) = -1.45$, $p = .15$. Here again, scores did not differ as a function of the propensity degree (high vs. low); $t(111) = 1.02$, $p = .31$.

In other words, when the computer forecast for the probability of guilt was low, the phrases produced focused on the possibility of the suspect's innocence (negative directionality), albeit to a lesser extent in the presence of a profile, whatever the level of propensity to have committed the offence implied by the profile. In contrast, when the computer forecast was high, the phrases produced focused on the possibility of the suspect's guilt (positive directionality) to the same extent whether no profile or a high guilt propensity profile were presented. When the suspect's profile indicated a lower propensity of having committed the offence, however, the positive directionality of the phrases produced was less marked, indicating that participants chose phrases that focused less intensively on the suspect's guilt in this instance.

Discussion

This paper examined the determinants of verbal probability choice. Specifically, this study aimed to explain why one may choose to say *there is a chance* instead of *it's not certain* when describing the possible guilt of a suspect. Two factors were manipulated: the objective numerical probability of guilt and the propensity of guilt. Our results first showed that the objective probability has a strong impact on the numerical value evoked by the verbal probability chosen. Participants chose low probability terms when they had to communicate a probability of 20% and high probability terms when they had to communicate a 80% probability. In other words, they chose terms whose underlying probability level was congruent with the objective numerical probability given by the computer program. This result therefore confirms that people actually choose expressions which match the value they bear in mind (Teigen & Brun, 1995, 1999 ; Budescu et al., 2003 ; Moxey & Sanford, 1997).

The second main result of this experiment is that probability values affected the directionality of the uncertainty expression chosen by speakers. When participants had to describe a 20% probability that a suspect is guilty, they always used negative terms. Conversely, to describe an 80% probability, participants always used positive verbal probabilities. On the one hand, this result replicates the evidence showing that the numerical probability and the directionality conveyed by a verbal probability are closely related (Teigen & Brun, 1995 ; Budescu et al., 2003). It gives even more support to the quantitative perspective (Budescu et al., 2003 ; Wallsten et al., 1986), as it is in line with the robust and systematic relation found between directionality and membership peak location (Budescu et al., 2003). Yet, on the other hand, it is surprising because it does not exhibit the traditional positivity bias (Teigen & Brun, 1995, 2003 ; Budescu et al., 2003). This bias is defined as the use of positive verbal probability for both low and high probability outcomes. Yet, none of our participants used a positive term to describe the 20% probability of guilt. This is all the more surprising given that there are more positive terms available than negative terms (Reagan, Mosteller, & Youtz, 1989 ; Beyth-Marom, 1982 ; Brun & Teigen, 1988). For instance, when Brun et Teigen (1988) collected probabilistic phrases from TV newscasts, 81% contained positive affirmations.

One explanation for this "negativity bias" could be that numerical probabilities tend to encourage analytical and rule-based reasoning (Windschitl & Wells, 1998). It might thus be possible that receiving an objective numerical probability anchored participants in an analytical mode of reasoning, inciting them to put more weight on the probability value and less on pragmatical cues (such as the propensity of guilt).

Alternatively, participants may have been reluctant to focus on the possibility of guilt when told there was a 20% probability that the suspect was guilty because in doing so they would

risk wrongly accusing an innocent man. Finally, this phenomenon could also have been enhanced by the "*postdiction effect*" which postulates that people feel more uncomfortable guessing in postdiction situations because a mistake would somehow be experienced as more embarrassing or painful than a mistake in prediction (Brun & Teigen, 1990). Indeed, the situation the participants had to judge had already occurred. Therefore, at the time of judgment, the suspect *was* or *was not* actually guilty. Thus, in some cases, individuals may take a cautious approach and choose a verbal probability that is congruent with the numerical probability they intend to convey. Further research could investigate under what conditions this does not hold. For example, one could examine whether people still choose negative uncertainty expressions to communicate a 20% probability of guilt when the costs of letting a criminal run loose are made more salient.

The third main result of this experiment is that propensity levels affected the directionality of the uncertainty expression chosen by speakers at each different level of numerical probability. This result lends support to the pragmatic perspective which considers that verbal probabilities convey more than the peak and skew of fuzzy numerical values. It is worth noting that propensity of guilt did not influence the peak location of membership functions. Even if they are correlated, numerical probability value and directionality could have different determinants. As Teigen et Brun (1995, p. 235) proposed, directionality may be "related to, but not determined by the corresponding p magnitude". This result is in line with the assumption that numerical probabilities tend to encourage analytical and rule-based reasoning and verbal probabilities allow for more associative and intuitive reasoning (Windschitl & Wells, 1998). This would explain why numerical meanings of verbal probabilities were influenced by the objective probability whereas verbal probability directionality, which has more pragmatic orientation, could also be influenced by the subjective perception of the suspect's disposition to commit the offence.

Finally, although perceived propensity of guilt did not overturn the directionality suggested by the objective numerical probability to be conveyed, it nevertheless had a significant impact on the "*intensity*" of word directionality, for a given objective probability. This indicates that people are able to make fine distinctions between probability words that convey similar numerical probabilities while focussing the occurrence or the non-occurrence of the outcome with varying intensities. This suggests, in turn, that directionality might be a continuous rather than a dichotomous concept, as past researchers have assumed. Several researchers examined the intensifying functions of quantifiers in verbal probability expressions. For example, Teigen et Brun (1999, p. 158) acknowledged that a "strong quantifier added to a positive phrase will emphasize the occurrence of the target outcome. Added to a negative phrase it will have the opposite effect". For example, "it is *highly* likely that the suspect is guilty" will emphasize the possibility of guilt whereas, "it is *highly* doubtful" will emphasize the possibility of innocence. Our results further suggest that this change in emphasis might be revealed by a change in perceived directionality intensity.

This last result has important consequence for forensic applications. It suggests that subjective perceptions of a suspect's predisposition to be guilty may result in the use of probability words that may well convey similar levels of uncertainty but will also determine the strength of the attention focus on the suspect's guilt or innocence. This calls for further research on the impact of directionality intensity in legal advice, but also in financial or medical advice.

This study presents, admittedly, a methodological shortcoming that would need to be addressed in future research. We first asked participants to produce a verbal probability describing their opinion of a suspect's guilt based on a numerical probability and, later on, to provide a membership function for this same expression. One could argue that this procedure created biased evaluations of the distribution of probability values the sentence seems to convey. Thus, the large effect of the objective numerical probability of guilt on peak membership values could be "simply" due to an "anchoring effect" (see, e.g., Chapman & Johnson, 2002). One way to resolve this issue would be to use independent coders for directionality and membership ratings. The problem with this procedure, however, is that it requires participants to choose a verbal probability from a limited number of expressions provided by the experimenter. It is not well suited to the study of verbal expressions *produced* by participants for two reasons. First, the expressions produced are usually numerous and diverse. Secondly, the highly documented inter-individual variability in estimates of the objective probability communicated by a given verbal probability suggests that the independent-rating method would be inappropriate. Suppose a lack of correspondence between (a) the objective numerical probability at the origin of the production of a verbal probability and (b) the peak value of that verbal expression as estimated by an independent coder is observed. It would be impossible to know whether such a discrepancy were due to a bias at the production stage or at the coding stage. Future research, however, could put in place better guards against a possible anchoring effect by leaving more time (e.g., a couple of weeks) between the elicitation of the verbal probability and the membership and directionality ratings.

More generally, this research also has implications for work on heuristics and biases in judgments of uncertainty. For example, work on anchoring effects (see, e.g., Chapman & Johnson, 2002) has not yet, to our knowledge, studied the effect of a numerical anchor on uncertainty judgments expressed verbally. Our results have implications for this issue as well. They show that verbal probability choices are also prone to anchoring effects. Although, in the present study, participants were explicitly asked to use the anchor when choosing their verbal probability, future research could look at the effect of irrelevant numerical anchors on probability judgments expressed verbally. Likewise, the present re-

sults suggest that participants heavily relied on the suspect's prior probability of guilt (as defined by the objective numerical probability provided by the computer program) contrary to what has been observed when probability judgments are elicited using numerical estimates (see, e.g., Kahneman & Frederick, 2002). Here again, this suggests that well established results in the literature on judgments of uncertainty may not hold when those judgments are elicited using verbal probabilities.

In conclusion, this study sheds light on the factors that influence speakers choices of words. It revealed that verbal probability production is based on the numerical level of probability that the speaker intends to convey as well as the desired intensity of the focus on the occurrence or non-occurrence of an outcome. Such intensity was shown to be influenced by the outcome's perceived propensity to occur. Our results support the claim that the meaning of uncertainty expressions cannot be reduced to a unidimensional quantitative scale, by confirming that verbal probability have different properties which themselves have different determinants.

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